

Industrial Process Market Analysis

Identifying opportunities for industrial energy efficiency

Minnesota Technical Assistance Program



UNIVERSITY OF MINNESOTA

Driven to DiscoverSM

Agenda

- Project introduction / overview
- Sector information and opportunities
 - Conservation opportunities
 - Industry case studies
- Next steps and action items

The Project

- Purpose
 - Investigate savings for industrial users
 - Industrial users account for 30% of energy use
 - Help identify opportunities to meet Next Generation Act Goals
 - Identify process-specific energy use
 - Identify conservation opportunities and savings potential
 - Technologies identified for energy efficiency
 - Process changes also identified

Completing the Project

Collect utility data



Determine sectors



Identify sub-sectors



Develop savings estimates



Make recommendations

Participating Utilities

- Alliant Energy
- CenterPoint Energy
- Greater Minnesota Gas
- Great Plains Gas
- Minnesota Energy Resources Corporation
- Otter Tail Power Company
- Xcel Energy

Completing the Project

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Determine sectors

Identify sub-sectors

Develop savings estimates

Make recommendations

Sectors

Four Primary

- Chemical manufacturing
- Primary metals
- Fabricated metals
- Food processing

Utility-Selected

- Wood products
- Printing
- Pulp & Paper
- Industrial Drying

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Sector	Recommended Sub-Sectors	
Chemical Manufacturing	Ethanol production Pharmaceutical manufacturing Resin production	Shingle manufacturing Explosives manufacturing Compressed gas
Food Processing	Vegetable canning/processing Meat processing Dried foods Margarine manufacturing Poultry processing Sunflower seed/wild rice processing Pet food manufacturing	Cheese and butter processing Rendering Soybean processing Food processors with water heating Commercial baking Snack chip production
Fabricated Metals	Sheetmetal products Plating, polishing and finishing Ordnance & ammo manufacturing Computer components	Metal tube manufacturing Metal can manufacturing Machining & custom tool/die shops Medium-duty equipment mfg
Primary Metals	Aluminum operations Heat treating operations	Iron operations

Sector	Recommended Sub-Sectors	
Printing	Web-fed heatset printers Newspaper, periodical, and book printers	Non heatset printers
Pulp and Paper	Pulp and paper mills Multi-wall converting w/heatset ops	Board converting, non-heatset
Wood Products	OSB Production	Sawmill operations

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Develop savings estimates



Make recommendations

Energy Savings Estimates

- Developing savings estimates
 - Reports or case studies with estimates for changes
 - Reports or fact sheets on technologies with estimates
 - DOE Industrial Assessment Center (IAC) recommendations

Savings Estimate Limitations

- Energy savings estimates
 - Represent savings over time
 - Time varies from facility to facility
 - Estimates represent cumulative savings
 - Are based on implementation; technologies demonstrated as economically feasible
 - Process change savings may be underestimated
 - Were developed without knowledge of economics of each specific facility

Completing the Project

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Rebate Information

- Rebate analysis
 - Highlighted what rebates were offered
 - Adjusted savings estimates to account for projects already completed
- Rebate findings
 - Lighting and motors were offered and used the most often
 - Some utilities can offer more rebates
 - Utilities might link rebates to usage information
 - More clear idea of customer needs
 - Can improve verification process

Sector	Electric Customers			Gas Customers		
	# of facilities	Annual Use (kWh)	% of total	# of facilities	Annual Use (therms)	% of total
Food Proc.*	669	995,587,111	27%	178	106,129,160	33%
Fab. Metals*	1,538	995,604,083	27%	693	28,913,817	9%
Chemical Mfg*	202	481,865,516	14%	126	121,846,681	38%
Printing	1,071	450,170,000	12%	330	12,645,000	4%
Pulp and Paper	89	364,166,000	10%	39	28,758,000	9%
Primary Metals*	164	274,607,105	8%	73	17,897,256	6%
Wood Products	12	60,404,718	2%	-	-	-
Other	-	-	-	77	2,959,482	1%
TOTAL	3,745	3,622,404,533	100%	1,516	319,149,396	100%

Food Processing

- Poultry
- Cheese
- Bakeries
- Vegetables
- Meat
- Dried foods
- Animal food
- Grains
- Soybeans
- Snacks
- Margarine
- Sugar beets

Electrical Savings – Food Processing

Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
Poultry Processing	32	115,000,000	17,000,000	15%
Cheese Processing	19	76,246,307	10,510,200	14%
Commercial Bakeries	46	61,000,000	9,000,000	15%
Meat Processing	5	34,215,492	5,719,400	17%
Fruit and Vegetable Canning	5	26,910,996	2,703,900	10%
Soybean Processing	1	21,509,620	1,112,100	5%
Sunflower Seed & Wild Rice Processing	2	13,521,747	943,600	7%
Snack Chip Production	1	10,951,560	876,100	8%
Pet Food Manufacturing	1	10,654,189	625,700	6%
Margarine Manufacturing	1	10,182,948	441,800	4%
Dried Products	2	6,357,072	833,700	13%
TOTAL	115	386,549,931	49,766,500	13%

Food Processing Electric Opportunity	Electric Savings Estimate	Sub-Sectors										
		Fruit & Veg	Dried Food	Meat	Margarine	Cheese	Poultry	Bakery	Seed & Rice	Pet Food	Snack	Soybean
Compressed air improvements	1-3%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Improved process equipment	9.7%	✓	✓		✓	✓	✓	✓		✓	✓	✓
Refrigeration improvements	1-20%	✓	✓	✓	✓	✓	✓					
Pump & Fan improvements	2-10%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Motor improvements	1-1.5%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Process improvements	2-4%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Facility HVAC & Lighting	0.5-5%	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

Gas Savings – Food Processing

Sub-sector	# of Facilities	Total Use (therms)	Remaining Savings (therms)	Est. Savings (%)
Dried Foods	9	9,506,837	110,040	1%
Poultry Processing	17	9,104,747	661,978	7%
Cheese and Butter Processing	4	8,777,522	677,921	8%
Rendering	3	7,609,636	1,155,292	15%
Fruit and Vegetable Canning	9	7,126,977	372,544	5%
Meat Processing	2	1,437,624	26,200	2%
Margarine Manufacturing	1	422,316	65,700	16%
Commercial Baking	10	341,488	64,400	19%
Soybean Processing	1	330,416	45,000	14%
TOTAL	100	44,987,979	3,179,000	7%

Food Processing Gas Opportunity	Thermal Savings Estimate	Sub-Sectors								
		Bakeries	Fruit & Veg	Rendering	Dried Food	Meat	Soybean	Poultry	Margarine	Cheese
Boiler improvements / best practices	1-8%	✓	✓	✓	✓	✓	✓	✓		
Direct fired improvements /best practices	0.1-1%	✓			✓		✓	✓		✓
Process equipment heat recovery	0.5-13%	✓		✓		✓	✓	✓		✓
Improved process equipment	0.5-4%	✓	✓	✓	✓	✓	✓	✓	✓	✓
Product wash improvements	1%		✓							
Steam best practices and improvements	0.5-11%		✓	✓	✓		✓	✓	✓	✓
Water heating improvements	to 20%	✓	✓	✓	✓	✓		✓	✓	✓
Facility HVAC & Lighting	1-8%	✓	✓							

Success Story: Process Changes

- Bongards' Creameries – Perham
 - Cheese processing plant
 - Otter Tail Power Company client
- Changes make big impact
 - Extract water at beginning of process
 - Lighting, compressed air, energy audits
- Impact
 - 1.6 million kWh
 - \$114,772 in rebates and grants

Information from Otter Tail Power Company Newsletter, 01/2009

Fabricated Metals

- Machine shops
- Sheet Metal
- Stamping
- Equipment manufacturers
- Plating and Polishing
- Ammunition
- Metal Can
- Metal tubes
- Computers

Electrical Savings – Fabricated Metals

Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
Machine Shops	520	176,944,411	61,115,414	35%
Computer Components	55	141,860,215	24,144,971	17%
Metal Can Manufacturing	5	47,876,568	17,232,701	36%
Medium-duty Equipment Mfg	20	7,695,572	1,031,700	13%
Sheetmetal Products	2	4,622,495	832,000	18%
Plating, Polishing and Finishing	2	882,455	154,400	17%
TOTAL	604	379,881,716	104,511,186	28%

Fabricated Metal Sector Electric Opportunity	Electric Savings Estimate	Sub-Sectors					
		Sheetmetal	Plating, Polishing,	Metal Can	Machine Shops	Computer	Medium Duty Equip
Process improvements & optimization	2-9%	✓	✓		✓		✓
Pump and fan optimization	1-6%	✓	✓	✓		✓	
Compressed air improvements	1-9%	✓	✓	✓	✓	✓	✓
Process motor optimization	1-4%	✓	✓	✓	✓		✓
Electrochemical process efficiency	10%		✓				
Welding system controls	1%	✓		✓			✓
Facility HVAC and lighting	1-6%	✓	✓	✓	✓	✓	✓

Gas Savings – Fabricated Metals

Sub-sector	# of Facilities	Total Use (therms)	Remaining Savings (therms)	Est. Savings (%)
Plating, Polishing, and Finishing	28	4,248,501	806,500	19%
Ordnance & Ammo Manufacturing	6	3,363,437	553,554	16%
Machine Shops	608	2,447,014	736,858	30%
Metal Can Manufacturing	7	1,182,037	264,631	22%
Metal Tube Manufacturing	4	1,026,337	381,647	37%
Sheetmetal Products	20	546,435	129,700	24%
Computer Components	55	131,498	26,300	20%
TOTAL	728	12,945,259	2,899,190	22%

Fabricated Metals Gas Opportunity	Thermal Savings Estimate	Sub-Sectors						
		Sheetmetal	Plating, Polishing,	Ordnance & Ammo	Metal Tube	Metal Can	Machine Shops	Computer
Process heat system optimization	1-20%	✓	✓		✓	✓		✓
Boiler / burner improvements	1-5%	✓	✓	✓	✓	✓		
Insulation	2-4%	✓	✓					
Process ventilation improvement	3-6%	✓	✓	✓	✓	✓		✓
Heat recovery	2-30%			✓	✓	✓	✓	
Facility HVAC Lighting	5-18%	✓	✓	✓	✓	✓	✓	✓

Success Stories

- Arctic Cat – Thief River Falls
 - Manufactures recreational vehicles
 - Increased efficiency of compressed air system
 - Saved 390,000 kWh and \$21,000
- Tennant Company – Golden Valley
 - Manufactures floor maintenance equipment
 - Installed steam control valves on 55 unit heaters
 - Eliminated compressed air leaks
 - Investigated new chemicals to reduce steam use
 - Saved 23,000 therms, 33,000 kWh, \$18,000

Chemical Manufacturing

- Ethanol
- Pharmaceuticals
- Resins
- Industrial gases
- Explosives
- Asphalt
- Perfumes/cosmetic
- Agricultural chemicals
- Adhesives
- Paints
- Dyes
- Surface cleaning products
- Nitrogen fertilizer

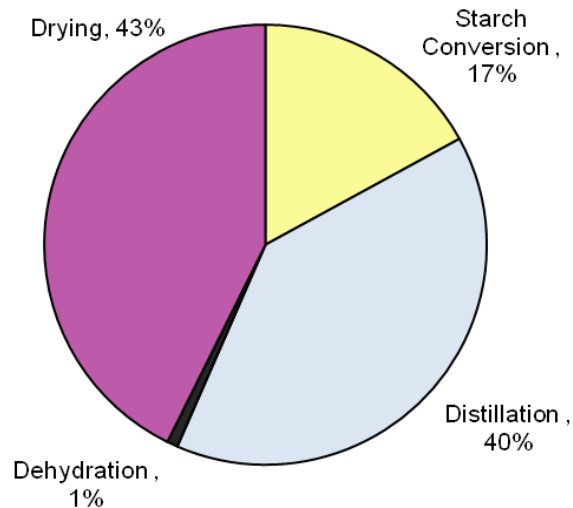
Electrical Savings - Chemical Manufacturing

Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
Compressed Gas	6	197,082,727	27,590,000	14%
Ethanol Production	10	144,470,209	4,675,900	3%
Shingle Manufacturing	1	33,829,875	8,460,000	25%
TOTAL	17	375,382,811	40,725,900	11%

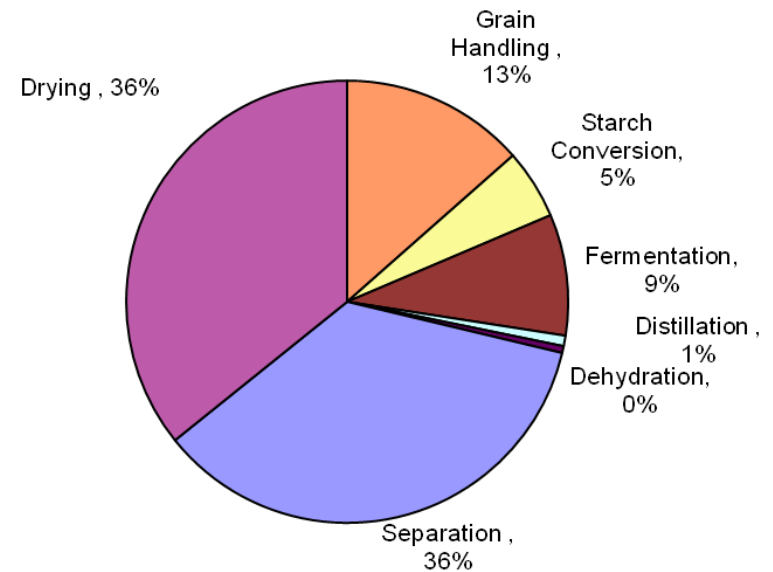
Chemical Manufacturing Electric Opportunity	Electric Savings Estimate	Sub-Sectors		
		Ethanol	Comp. Gas	Shingle
Corn fractionation	8%	✓		
Increase screen size on hammer mill	2%	✓		
Not drying stillage	30%	✓		
Replace hammer mills with roller mills	4%	✓		
Motor optimization	1-2%	✓	✓	✓
Pump and fan optimization	1-4%	✓		✓
Insulate heaters	1%			
Air compressor system optimization	2-25%		✓	✓
Process control improvements	2-6%			✓
Process heat system improvements	1%			✓
Facility HVAC & Lighting	2-10%		✓	✓

Ethanol Energy Footprint

Fuel Use



Electric Use



Gas Savings - Chemical Manufacturing

Sub-sector	# of Facilities	Total Use (therms)	Remaining Savings (therms)	Est. Savings (%)
Ethanol Production	10	115,564,147	13,600,000	12%
Pharmaceutical Mfg	15	2,191,809	344,400	16%
Resin Production	1	834,758	51,500	6%
Compressed Gas	6	102,942	13,900	13%
Explosives Manufacturing	1	77,327	12,300	16%
Asphalt	1	161,700	16,200	10%
TOTAL	33	118,770,983	14,038,300	12%

Chemical Manufacturing Gas Opportunity	Thermal Savings Estimate	Sub-Sectors					
		Ethanol	Pharm.	Resin	Asphalt	Explosives	Comp. Gas
Corn fractionation	15%	✓					
Preheat drying combustion air	4%	✓			✓		
Not drying stillage	30%	✓					
Cold cooking	4%	✓					
Process ventilation improvements	1-5%		✓				
Process heat system optimization	5-10%		✓			✓	
Heat recovery	2-10%	✓	✓	✓		✓	
Thermal oxidizer upgrade	20%			✓			
Boiler system improvements	3-10%	✓	✓	✓			
Insulation improvements	1-2%	✓		✓	✓		
Cover aggregate piles in storage	10%				✓		
Facility HVAC & lighting improvements	2-10%		✓			✓	✓

Primary Metals

- Aluminum operations
 - Foundry
 - Die Casting
- Iron Foundries
- Heat Treating

Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
Aluminum Operations	23	100,652,913	14,266,233	14%
Iron Operations	17	88,904,942	16,002,889	18%
Heat Treat Operations	10	36,436,318	3,643,632	10%
TOTAL	50	225,994,173	33,912,754	15%

Primary Metals Electric Opportunity	Electric Savings Estimate	Sub-Sectors		
		Aluminum Operations	Heat Treating Operations	Iron Operations
Process heat system optimization	1-5%	✓		
Materials processing improvements	1-2.3%	✓		✓
Pump and fan optimization	1-7%	✓		
Existing furnace optimization	9-18%	✓	✓	✓
Compressed air optimization	1.6%	✓		
Facility improvements	1.5%	✓		✓

Gas Savings – Primary Metals

Sub-sector	# of Facilities	Total Use (therms)	Remaining Savings (therms)	Est. Savings (%)
Aluminum Operations	35	11,407,286	572,200	5%
Heat Treating Operations	15	3,027,292	73,000	2%
Iron Operations	20	2,305,370	381,400	17%
TOTAL	70	16,739,948	1,026,650	6%

Primary Metals Gas Opportunity	Thermal Savings Estimate	Sub-Sectors		
		Aluminum Operations	Heat Treating Operations	Iron Operations
Fired heaters upgrades/optimization	6-10%	✓		✓
Furnace optimization	2-12%	✓	✓	✓
Process heat optimization	2-16%	✓		
Waste heat recovery	6-10%	✓	✓	

Success Stories

- Twin Cities Die Casting – Minneapolis
 - Manufactures parts for recreational vehicles
 - Evaluated furnace inefficiencies
 - Worn out equipment
 - High oxygen levels (>2%)
 - Misplaced or misfit well covers
 - Investigated compressed air inefficiencies
 - Compressor room temperature and storage
 - System maintenance
 - Could save approximately 720,000 kWh, 50,000 therms, and \$100,000

Printing

Electric Savings – Printing				
Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
Non Heatset Printing	734	312,128,662	43,814,000	14%
Web-fed Heatset Printers	31	65,234,908	8,508,000	13%
Newspapers, Periodicals, & Books	261	57,616,843	7,695,000	13%
TOTAL	1026	434,980,413	60,017,000	14%

Printing Electric Opportunity	Electric Savings Estimate	Sub-Sectors		
		Web-fed Heatset	Non-heatset Printing	Newspapers, Periodicals, Books
Air compressor improvements	3-4%	✓	✓	✓
Motor system improvements	5-7%	✓	✓	✓
Pump system improvements	1%	✓		✓
Facility improvements (lighting, etc.)	1-4%	✓	✓	✓

Gas Savings – Printing

Sub-sector	# of Facilities	Total Use (therms)	Remaining Savings (therms)	Est. Savings (%)
Web-fed Heatset Printers	56	10,477,745	1,251,397	12%
Non Heatset Printing	181	927,338	138,000	15%
Newspapers, Periodicals, & Books	60	550,911	80,000	15%
TOTAL	297	11,955,994	1,469,397	12%

Printing Gas Opportunity	Thermal Savings Estimate	Sub-Sectors		
		Web-fed Heatset	Non-heatset Printing	Newspapers, Periodicals, Books
Improve/replace thermal oxidizers	1-3%	✓		
Improve dryer efficiency	2-6%	✓		
Humidification improvements	1-3%	✓	✓	✓
Facility HVAC improvements	1-5%	✓	✓	✓

Pulp and Paper

- Sub-sectors
 - Pulp and paper mills
 - Multi-wall converting w. heatset operations
 - Board converting, non-heatset

Electric Savings – Pulp & Paper

Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
Pulp and Paper Mills	9	227,733,691	24,505,000	11%
Board converting	68	98,991,745	4,929,000	5%
Multi-wall converting	8	19,415,808	2,026,000	10%
TOTAL	85	346,141,244	31,460,000	9%

Pulp and Paper Electric Opportunity	Electric Savings Estimate	Sub-Sectors		
		Pulp and paper mills	Multi-wall converting	Board converting
Motor system improvements	4-7%	✓	✓	✓
Process control improvements	1-3%	✓	✓	✓
Compressed Air improvements	2-4%	✓	✓	✓
Pump system improvements	.5-2%	✓		
Power from steam pressure reduction (CHP)	.5%	✓		
Facility HVAC improvements	0.5-1%	✓	✓	✓

Gas Savings – Pulp & Paper

Sub-sector	# of Facilities	Total Use (therms)	Remaining Savings (therms)	Est. Savings (%)
Pulp and paper mills	7	12,600,827	1,167,000	9%
Multi-wall converting	6	1,073,189	120,000	11%
TOTAL	13	13,674,016	1,287,000	9%

Pulp and Paper Gas Opportunity	Thermal Savings Estimate	Sub-Sectors	
		Pulp and paper mills	Multi-wall converting
Boilers system best practices	3-5%	✓	✓
Process control improvements	1-5%	✓	✓
Heat Recovery	1-6%	✓	✓
Drier and process insulation improvements	1-4%		✓
Thermal oxidizer improvements	1-2%		✓
Facility improvements (lighting, etc.)	1-2%	✓	✓

Wood Products

- Sub-sectors
 - Oriented strand board production
 - Sawmill operations

Electric Savings				
Sub-sector	# of Facilities	Total Use (kWh)	Remaining Savings (kWh)	Est. Savings (%)
OSB Production	1	43,211,000	7,349,000	17%
Sawmill Operations	4	13,296,340	2,369,400	18%
TOTAL	5	56,507,340	9,718,400	17%

Wood Products Electric Opportunity	Electric Savings Estimate	Sub-Sectors	
		Oriented strand board	Sawmill operations
Process improvements	1-7%	✓	✓
Fan System improvements	2-5%	✓	
Compressed Air improvements	3-6%	✓	✓
Motor improvements	2-7%	✓	✓
Facility improvements (lighting, etc.)	1-3%	✓	✓

Cross-Sector Opportunities

Electric

- Compressed air
- Motor & drives
- Pumps & fans
- Process controls
- Refrigeration

Gas

- Burners & burner controls
- Heat recovery
- Steam system best practices
- Thermal oxidizer

Next Steps for Utilities

- Focus on industrial customers to help reach energy saving goals
- Use information from study to approach industrial facilities about energy-saving opportunities
- Provide greater incentives to industrial clients through expanded rebate programs

Action Items

- Greater collaboration between gas and electric utilities
- Utilize MnTAP resources including assessments and trainings